IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Before the Board of Patent Appeals and Interferences

OIPE JC19 APR 25 2003 PATENT & TRADEMARK OFFICE

AF/2613 #11 5-7-03 P.Z

In re Patent Application of — Atty Dkt. 2466-35 — 23117

C# M#

CHRISTOPOULOS et al. — Group Art Unit: 2613

Serial No. 09/394,428 — Examiner: Behrooz M. Senfi

Filed: September 13, 1999 — Date: April 25, 2003

Title: DOWN SCALING OF IMAGES

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☐	**NOTICE OF APPEAL** Applicant hereby appeals to the Board of Appeals from the decision dated ______________ of the Examiner twice/finally rejecting claims ______________ ($ 320.00)	$	
☒	An appeal **BRIEF** is attached in triplicate in the pending appeal of the above-identified application ($ 320.00)	$	320.00
☐	Credit for fees paid in prior appeal without decision on merits	-$ (	)
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1100 North Glebe Road, 8th Floor
Arlington, Virginia 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100
JRL:lrb

NIXON & VANDERHYE P.C.
By Atty: John R. Lastova, Reg. No. 33,149

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In re Patent Application of

CHRISTOPOULOS et al. Atty. Ref.: **2466-35**

Serial No. **09/394,428** Group: **2613**

Filed: **September 13, 1999** Examiner: **B.M. SENFI**

For: **DOWN SCALING OF IMAGES**

Before the Board of Patent Appeals and Interferences

BRIEF FOR APPELLANT

On Appeal From Rejection
dated October 29, 2002
from Group Art Unit 2613

John R. Lastova
NIXON & VANDERHYE P.C.
8th Floor, 1100 North Glebe Road
Arlington, Virginia 22201-4714
(703) 816-4025
Attorney for Appellant
CHRISTOPOULOS et al.
Telefonaktiebolaget LM Ericsson (publ)

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April 25, 2003

Honorable Commissioner of Patents
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APPEAL BRIEF

Sir:

This is an appeal from the Examiner's Final Rejection dated October 29, 2002.[1]

REAL PARTY IN INTEREST

The real party in interest is the assignee, Telefonaktiebolaget LM Ericsson (publ) of Stockholm, Sweden.

RELATED APPEALS AND INTERFERENCES

There are no other appeals related to the subject application. There are no interferences related to the subject application.

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[1] The claims on appeal appear in Appendix A accompanying this Brief.

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STATUS OF CLAIMS

Claims 1-4 and 9-26 are pending on this appeal. Claims 5-8 are cancelled. Claims 1-2, 4, 9-12, 14-16, 18-21 stand rejected for obviousness based upon U.S. Patent No. 5,107,345 to Lee. Claims 9, 22-23, and 25-26 stand rejected under 35 USC §103 as being unpatentable over Lee in view of U.S. Patent No. 5,870,146 to Zhu. Claims 3, 13, 17, and 24 stand objected to as containing allowable matter.

STATUS OF AMENDMENTS

No amendment after final has been filed.

SUMMARY OF INVENTION

When a video signal is transmitted, it is typically compressed, and the receiver decompresses the received signal to reconstruct the video signal. Image compression typically employs three stages: source encoding, quantizing, and entropy encoding. The source encoder is usually a linear transform that distinguishes different frequency components of an image. The Discrete Cosine Transform (DCT) is commonly used. The DCT converts a video signal in the time domain into a signal in the frequency domain to separate the image into parts (spectral sidebands) of differing importance (with respect to the image's visual quality). Image compression standards like JPEG, MPEG-1, MPEG-2, H.261, and H.263 use DCT or block transform based techniques.

A typical transform coding system divides an input image into fixed block sizes, e.g., 8x8 or 16x16 pixels. At the transmitter, each block is DCT transformed. For example, an 8x8 DCT transforms an 8x8 pixel block (8-bits per pixel) into an 8x8 DCT coefficient block (64-bits per DCT coefficient). The DCT coefficients may be scaled, e.g., more bits for values corresponding to lower frequencies and fewer bits for values corresponding to higher frequencies.

Transmission of video with different Qualities of Service (QoS) requires different bit rates. Varying traffic load over a communications link or network requires adaptation of bit rate to available channel capacity. A "scalable" coding scheme, like DCT based coding, allows users having a different QoS to communicate with each other, e.g., a subscriber with a lower quality video service can decode and reconstruct a higher quality video signal albeit at the lower QoS level.

Many scalable coding systems require more than one size DCT in order to adapt to different QoS requirements or different capacity constraints. To have this flexibility, different size DCTs must be supported, e.g., 2x2, 4x4, 8x8, 16x16 DCTs. In that case, the encoder must be able to perform all of the different size DCTs, and the decoder must be able to handle the different size inverse DCTs (IDCTs). But there are situations where only one size DCT is available, e.g., only 8x8 DCTs. Another drawback is that smaller DCTs may not be as efficient as larger DCTs, e.g., 4x4 DCTs are not as efficient as 8x8 DCTs.

The present invention overcomes the problems associated with using different size DCTs. An N-point DCT is determined using only N/2 DCT transforms. The advantage of this approach is demonstrated in the example context of a digital image transmission system shown in Fig. 1. Different capability users 101, 103, and 15 are connected to each other via an MCU 107. Users 101 and 105 have 128 kbps connections, but user 103 only has a 28.8 kbps connection. If users 101 and 105 transmit video signals in a higher QoS CIF format, user 103 cannot receive that video because of limited transmission bandwidth unless the MCU performs some kind of bit reduction of the video signal.

One way of obtaining this bit reduction at the MCU is to extract only the 4x4 low frequency coefficients of the 8x8 DCT coefficients from the incoming video from users 101 and 105 and to transmit only these 4x4 low frequency coefficients to user 103. User 103's receiver can then reconstruct the incoming frames in a lower QoS QCIF format through appropriate scaling of the motion vectors. But a better approach is to extract low frequency 8x8 DCT coefficients from 16x16 blocks of DCT coefficients and calculate the 16 x 16 DCT using sequences from the 8 x 8 DCTs. A 16 x 16 size DCT is not needed.

A DCT of length N/2 is calculated to produce two sequences of coefficients of length N/2, that represent the first and second half, respectively, of an original sequence of values of length N. A DCT of length N is then calculated from the two sequences of coefficients of length N/2. Similarly, a DCT of length N/2 x N/2 is calculated to produce four sequences of coefficients, and a DCT of length N x N is calculated directly from the four sequences of coefficients.

The mathematical explanation how this may be accomplished is set forth starting on page 5, and steps performed in the DCT domain are illustrated in Fig. 5. Fig. 2 illustrates steps for deriving a QCIF image from a CIF image without having to use any other size transforms than 8x8 DCTs. Various image compression downsampling applications are described beginning at page 22.

ISSUES

The issue presented in this appeal is whether the Examiner has failed to establish a prima facie case of obviousness of rejected claims 1, 4, 9-12, 14-16, 18-23, 25 and 26.

GROUPING OF CLAIMS

For convenience and not for purposes of limiting the scope of any of the grouped claims, claims 4, 9, 10, 12, 15, 17, 18, 20, and 21 stand or fall with claim 1. In this grouping, any means plus function claim construction for claim 20 is in no way to be imparted to any of the other claims in this group. Claims 14, 16, and 19 stand or fall with claim 11. Claim 24 stands or falls with claim 23.

ARGUMENT

A. Introduction

The Supreme Court, in the case of *Graham v. John Deere*, 383 US1, 148 USPQ 459 (1966) set forth the necessary factual inquiries to be made in determining the obviousness or non-obviousness of the claims at issue under 35 U.S.C. §103 as follows:

> [u]nder §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are ascertained; the level of ordinary skill in the art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined.

The Examiner has the burden under §103 of establishing a *prima facie* case of obviousness.[2] The final rejection fails to satisfy that burden.

B. Basis of the Rejection

In the primary rejection based on Lee as set forth in the first office action, the Examiner admits that Lee fails to teach computing an "N x N DCT directly from two sequences of length N/2 x N/2 and also N x N directly from four DCTs of four adjacent blocks." Nonetheless, the Examiner contends that Lee describes "dynamically treating DCT coefficient blocks...using variable block size (e.g. sub-block) such as 8 x8 or 4 x 4 and so forth for the purpose of reducing blocking artifiacts." Obviousness is alleged "to take advantage of Lee's teaching and modify the system, since Lee '345 in particular describe an adaptive DCT scheme coding and mentioned using variable block size for the benefit of the desired design, like speed up the processing." The Examiner also admits that Lee does not teach a transcoder, but relies on Zhu's teaching of a transcoder to convert bit rates.

[2] *In re Piasecki*, 223 USPQ 785 (Fed. Cir. 1984).

C. Lee Alone or in Combination with Zhu Fails to Disclose or Suggest the Combination of Features Recited in the Claims

Lee describes a method for compressing image data and employs a system for generating from a block of input pixel data a corresponding composite block of DCT data. The system also performs different size DCTs on different size sub-blocks of the block of pixel data. The DCT transform outputs corresponding blocks and sub-blocks of DCT coefficient values.

As the Examiner admitted in the first action, Lee does not disclose or suggest that it would be possible or advantageous to calculate a DCT of length N from DCTs of length $N/2$. In the example where $N = 16$, this feature permits obtaining a 16x16 DCT for a $16x16$ pixel block when only DCTs of $8x8$ pixel blocks are supported by existing hardware and/or software. Despite the Examiner's recognition of Lee's deficiencies, the Examiner opines it would have been obvious

> to take advantage of Lee's teaching [of using sub-blocks] and modify the system [Lee's system] since Lee '435 in particular describe an adaptive DCT scheme coding and mentioned using variable block size for the benefit of the desired design, like speed up the processing (i.e., column 8, lines 50+).

In essence, the Examiner contends it is obvious to modify Lee to calculate a DCT of length N directly from two sequences of coefficients of length $N/2$ because Lee teaches an adaptive block size DCT compression scheme. But at best such a modification would be obvious in hindsight only after reading the instant application.

Lee's idea is directed to something different than calculating longer length DCTs from shorter DCTs. In column 8, lines 28-35, Lee explains:

> The main distinction of the compression scheme of the present invention resides in the fact that the $16x16$ block is adaptively divided into sub-blocks with the resulting sub-blocks at different sizes also encoded using a DCT process. By properly choosing the

> block sizes based on the local image characteristics, much of the quantization error can be confined to small sub-blocks.

Lee's invention divides pixel blocks into sub-blocks to limit quantization error. Lee does not avoid the need to calculate a DCT of length *N*. Beginning at column 9, lines 13-14, Lee describes that the "*16 x 16 pixel block* is input to a *16 x 16 two-dimensional discrete cosine transform (DCT)* element 10a" (emphasis added). That same 16 x 16 pixel block is also

> input as four 8 x 8 pixel blocks to 8 x 8 DCT element 10b, as eight 4 x 4 pixel blocks to 4 x 4 DCT element 10c, and as sixty-four 2 x 2 pixel blocks to 2 x 2 DCT element 10d.

See Figure 1, which shows 16 x 16 DCT, 8 x 8 DCT, 4 x 4 DCT, and 2 x 2 DCT blocks 10a-10d, and Column 9, lines 15-18. Each one of these DCT elements 10a-10d performs two-dimensional DCT operations on each respectively sized input block of pixel data. For example, "DCT element 10a performs a single 16 x 16 transform operation." Column 9, lines 23-24. Transform coefficients from each of the four DCT elements 10a-10d are provided to a respective quantizer lookup table 12a-12d.

For Lee's 8 x 8 DCT element 10b, calculating a DCT of a block of size 8 x 8 (an array of 8 x 8 values) means calculating 8 x 8 DCT coefficients. So in this case, N = 8. Lee calculates 8 x 8 (i.e., N x N) DCT coefficients from the 8 x 8 input values of the 8 x 8 sub-block obtained from the division of the received 16 x 16 block. Hence, Lee uses a DCT of dimension NxN for each DCT sub-block calculation.

There is no teaching or motivation in Lee to support changing Lee to be like what is claimed. Lee is perfectly happy calculating a DCT of length N and assumes that there is DCT element of length N to perform an N-point DCT transform operation. In contrast, the present invention does not make that assumption.

As an example, if circuitry exists and/or it is desirable to perform 8 x 8 DCT transforms, the present invention provides a way to obtain DCTs for 16 x 16 pixel blocks from the 8 x 8 DCTs. A 16 x 16 DCT need not be used. This flexibility/capability is neither disclosed nor suggested in Lee. Nor does Lee explain how a DCT of length N x N may be calculated directly from four sequences of coefficients produced by calculating a DCT of length N/2 x N/2 without using DCTs of length N x N.

As the Examiner is aware, there must be some teaching or suggestion to modify a reference in a way that results in the claimed invention.[3] The Examiner seems to be suggesting that Lee *could* be modified to use the present invention. Nonetheless, the "mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification."[4] Lee simply does not provide the necessary motivation, and the only way one can arrive at the modification proposed by the Examiner is by reading the instant application. And even if the Examiner's modification were made, it is not clear how "varying the block size" permits or performs calculating a DCT of size N or N x N from DCT sequences of coefficients produced by calculating a DCT of size N/2 or N/2 x N/2.

Recognizing the hindsight nature and deficiency of the original rejection, the Examiner takes a different tack in the final rejection and argues that

> the present claims don't exclude the direct calculation of DCT of size N, simply put Lee '345 teaches (along with DCT of the size N) and multiple DCTs of N/2 being combined to produce DCT of size N.

This statement contradicts the Examiner's earlier admission in the first office action that Lee "does not explicitly teaches N x N directly from two sequence of length N/2 x N/2 and also N x N DCT directly from four DCTs of four adjacent blocks." In the first action, the Examiner properly understood that the claims did not cover "direct calculation of DCT of size N."

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[3] See *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990).

[4] *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984).

The Examiner's statement in the final action also ignores the fact that claim 1 recites:

> calculating a discrete cosine transform (DCT) of length N/2, N being a positive, even integer, to produce two sequences of coefficients of length N/2, that represent the first and second half, respectively, of an original sequence of values of length N.

The Examiner fails to point out where Lee teaches calculating N/2 DCTs or the two N/2 length sequences. Both of these features are required by claim 1 and are not taught by "direct calculation of DCT of size N."

Calculating DCTs of length 8x8 for the four 8x8 blocks that are obtained by dividing an original 16x16 pixel block is not the same as calculating a 16x16 DCT for the full block. The coefficients of the 16x16 DCT are not easily obtained from the coefficients of the 8x8 DCTs. As is apparent from the extensive mathematical explanation in the instant specification, it is rather tricky to obtain these 16x16 DCT coefficients from the coefficients of smaller block DCTs. There is no explanation in Lee of how such 16 x 16 DCT coefficients would be obtained from smaller size DCTs.

And contrary to the Examiner's contention quoted above, claim 1 requires "calculating a DCT of length N *directly* from the two sequences of coefficients of length N/2"—not from a DCT of length N. Lee does not teach this. Lee teaches calculating an N x N DCT using an N x N block. Even though Lee divides a 16 x 16 block into sixteen 4 x 4 sub-blocks and performing a 4 x 4 DCT on each 4 x 4 sub-block, Lee is still computing a DCT of length N=4 on a sequence/block of length N=4.

Thus, Lee also does not teach "calculating a DCT of length N x N *directly* from the four sequences of coefficients" of length N/2 x N/2 as recited in claim 2. Lee does not disclose "undersampling compressed frames by a certain factor in each dimension" coupled with "calculating a DCT of length N x N *directly* for four adjacent blocks of size N/2 x N/2" as recited in claim 11.

Regarding claim 22, Lee fails to teach:

- collecting the extracted coefficients for four adjacent blocks of size N/2 x N/2, the groups of four adjacent blocks forming together non-overlapping blocks of size N x N in the digitalized image;
- calculating, from the collected coefficients, coefficients of the DCTs for the blocks of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of the size N/2 x N/2 and without using DCTs or IDCTs of length N x N,
- selecting, from the calculated coefficients, coefficients of the lowest frequencies; and
- transmitting to the at least one user a bit stream including only the selected coefficients.

Lee does not calculate N x N DCT coefficients for N x N size blocks using DCTs and IDCTs of length N/2 "*without using* DCTs or IDCTs of length N" or using DCTs and IDCTs for blocks of the size N/2 x N/2 "without using DCTs or IDCTs of length N x N."

Regarding claim 23, Lee fails to teach and the Examiner fails to identify in Lee:

- collecting the extracted coefficients for four adjacent blocks of size N x N, the groups of four adjacent blocks forming together non-overlapping blocks of size 2N x 2N in the digitalized image;
- selecting, from the collected, extracted coefficients for each block of size N x N of each of the groups of four adjacent blocks of the size N x N, coefficients of N/2 x N/2 lowest frequencies;
- calculating, from the selected coefficients for each of the groups, coefficients of the DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N, and
- transmitting to the at least one user a bit stream including only the calculated coefficients.

Regarding claim 25, Lee fails to teach the claimed "multi-node control unit comprising:

- means for receiving said bit stream from the second one of the users and for extracting from the bit stream coefficients for blocks of size N/2 x N/2 in a corresponding digitalized image;

- means for collecting the extracted coefficients for four adjacent blocks of size N/2 x N/2;

- means for calculating from the collected coefficients coefficients for a DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N;

- means for selecting, from the calculated coefficients, coefficients for the lowest frequencies, and

- means for transmitting to the first one of the users a bit stream including only the selected coefficients."

Regarding claim ~~25~~ 26, Lee fails to teach the claimed "multi-node control unit comprising:

- means for receiving said bit stream from the second one of the users and for extracting from the bit stream coefficients for blocks of size N x N in a corresponding digitalized image;

- means for collecting the extracted coefficients for four adjacent blocks of size N x N;

- means for selecting, from the extracted coefficients for each of the four adjacent blocks, coefficients for N/2 x N/2 lowest frequencies;

- means for calculating, from the selected coefficients, coefficients for a DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N; and

- means for transmitting to the first one of the users a bit stream including only the calculated coefficients."

The final rejection makes no attempt to identify any of these features from claims 22, 23, 25, and 26 in Lee or Zhu.

CONCLUSION

The Examiner fails to provide any objective evidence other than the teachings of the instant application as to why the differences between the claimed invention and the cited prior art would have been obvious to a person of ordinary skill in the art. It is therefore respectfully submitted that the rejected claims patentably distinguish from Lee alone or Lee in combination with Zhu and are in condition for allowance. The Board is therefore requested to reverse the outstanding final rejection.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ________________________
John R. Lastova
Reg. No. 33,149

JRL:mm
1100 North Glebe Road, 8th Floor
Arlington, VA 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100

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APPENDIX A

CLAIMS ON APPEAL

1. An encoder or decoder, comprising:

- first processing circuitry for calculating a discrete cosine transform (DCT) of length N/2, N being a positive, even integer, to produce two sequences of coefficients of length N/2, that represent the first and second half, respectively, of an original sequence of values of length N, and

second processing circuitry for calculating a DCT of length N directly from the two sequences of coefficients of length N/2.

2. An encoder or decoder comprising:

- first processing circuitry for calculating a discrete cosine transform (DCT) of length N/2 x N/2, N being a positive, even integer, to produce four sequences of coefficients, and

- second processing circuitry for calculating a DCT of length N x N directly from the four sequences of coefficients.

3. The encoder or decoder of claim 1, wherein the second processing circuitry for calculating DCT of length N is arranged to calculate the even coefficients of the DCT of length N as:

$$X_{2k} = \sqrt{\frac{2}{N}}\varepsilon_{2k}\sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)2\kappa\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=N/2}^{N-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=0}^{\frac{N}{2}-1} x_{N-1-n} \cos\left[\frac{[2(N-1-n)+1]\kappa\pi}{2(N/2)}\right] \right\}$$

$$= \sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} z_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + (-1)^k Z_k\right]$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + Z'_k\right] \qquad k = 0,1,\ldots,(N/2)-1.$$

and the odd coefficients $R_k = X_{2k+1}$ as

$$R_k = R_k^{'} - R_{k-1}$$

where

$$R_k^{'} = \sqrt{\frac{2}{N}} \left\{ \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k+1)\pi}{2N} + \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k-1)\pi}{2N} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} (y_n - z'_n) 2\cos\frac{(2n+1)\pi}{2N} \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} r_n \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

or

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \{ \text{ length-N/2 DCT-II of } r_n \}$$

where

$$r_n = (y_n - z'_n)2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Y_l \cos\frac{(2n+1)l\pi}{2(N/2)} - \sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Z'_l \cos\frac{(2n+1)l\pi}{2(N/2)}\right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l (Y_l - Z'_l)\cos\frac{(2n+1)l\pi}{2(N/2)} - \right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= g_n 2\cos\frac{(2n+1)\pi}{2N}$$

where

g_n is a length-N/2 IDCT of $(Y_l - Z'_l)$, and where

$R'_k = X_{2k+1} + X_{2k-1}$.

or as

$$X_{2k+1} = \sqrt{\frac{2}{N}}\varepsilon_{2k+1}\sum_{i=0}^{N-1} x_i \cos\frac{(2i+1)(2\kappa+1)\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} x_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} x_{i+N/2}\cos\frac{(2i+N+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} z_i \cos\left[\frac{(2i+1)(2k+1)\pi}{2N} + (k\pi + \frac{\pi}{2})\right]\right\}.$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + (-1)^{k+1}\sum_{i=0}^{\frac{N}{2}-1} z_i \sin\frac{(2i+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}(X1_k - (-1)^k X2_k), \quad k = 0,1,\ldots,(N/2)-1.$$

4. An encoder or decoder of claim 1, wherein N is equal to 2^m, m being a positive integer > 0.

9. A transcoder comprising the encoder or decoder of claim 1.

10. A system for transmitting DCT transformed image or video data comprising the encoder or decoder of claim 1.

11. A method of encoding a digitalized image in a compressed discrete cosine transform (DCT) domain using DCTs of length N/2, comprising:

undersampling compressed frames by a certain factor in each dimension, and

calculating a DCT of length N x N directly from ~~DCTs for~~ four adjacent blocks of size N/2 x N/2 of the digitalized image, N being a positive, even integer. DCT coefficients

12. A method of encoding a digitalized image represented as a discrete cosine transform (DCT) transformed sequence of coefficients of length N, N being a positive, even integer, comprising:

calculating a DCT of length N directly from two sequences of coefficients of length N/2,

wherein the two sequences of coefficients are obtained from DCTs of length N/2 and represent the first half and second half, respectively, of an original sequence of digitalized images values of length N.

13. A method according to claim 12, wherein the even coefficients of the DCT of length N are calculated as:

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$$X_{2k} = \sqrt{\frac{2}{N}}\varepsilon_{2k}\sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)2\kappa\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=N/2}^{N-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=0}^{\frac{N}{2}-1} x_{N-1-n} \cos\left[\frac{[2(N-1-n)+1]\kappa\pi}{2(N/2)}\right] \right\}$$

$$= \sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} z_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + (-1)^k Z_k\right]$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + Z'_k\right] \qquad k = 0,1,\ldots,(N/2)-1.$$

and the odd coefficients $R_k = X_{2k+1}$ as

$$R_k = R_k^{'} - R_{k-1}$$

where

$$R_k^{'} = \sqrt{\frac{2}{N}} \left\{ \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k+1)\pi}{2N} + \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k-1)\pi}{2N} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} (y_n - z'_n) 2\cos\frac{(2n+1)\pi}{2N} \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} r_n \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

or

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \{ \text{ length-N/2 DCT-II of } r_n \}$$

where

$$r_n = (y_n - z'_n)2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Y_l \cos\frac{(2n+1)l\pi}{2(N/2)} - \sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Z'_l \cos\frac{(2n+1)l\pi}{2(N/2)}\right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l (Y_l - Z'_l)\cos\frac{(2n+1)l\pi}{2(N/2)} - \right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= g_n 2\cos\frac{(2n+1)\pi}{2N}$$

where

g_n is a length-N/2 IDCT of $(Y_l - Z'_l)$, and where

$R'_k = X_{2k+1} + X_{2k-1}$.

or as

$$X_{2k+1} = \sqrt{\frac{2}{N}}\varepsilon_{2k+1}\sum_{i=0}^{N-1} x_i \cos\frac{(2i+1)(2\kappa+1)\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} x_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} x_{i+N/2}\cos\frac{(2i+N+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} z_i \cos\left[\frac{(2i+1)(2k+1)\pi}{2N} + (k\pi + \frac{\pi}{2})\right]\right\}.$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + (-1)^{k+1}\sum_{i=0}^{\frac{N}{2}-1} z_i \sin\frac{(2i+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}(X1_k - (-1)^k X2_k), \quad k = 0,1,\ldots,(N/2)-1.$$

14. The method of claim 11, wherein N is equal to 2^m, m being a positive integer > 0.

15. A method of decoding a digitalized image represented as a discrete cosine transform (DCT) transformed sequence of coefficients of length N, N being a positive, even integer, comprising:

calculating a DCT of length N from two sequences of coefficients of length N/2,

wherein the two sequences of coefficients represent the first half and second half, respectively, of an original sequence of digitalized image values of length N.

16. A method of decoding a digitalized image in the compressed discrete cosine transform (DCT) domain using DCTs of lengths N/2, comprising:

undersampling compressed frames by a certain factor in each dimension, and

calculating a DCT of length N x N directly from DCTs for four adjacent blocks of sizes N/2 x N/2 of the digitalized image, N being a positive, even integer.

17. The method of claim 15, wherein the even coefficients of the DCT of length N are calculated as:

$$X_{2k} = \sqrt{\frac{2}{N}}\varepsilon_{2k}\sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)2\kappa\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=N/2}^{N-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=0}^{\frac{N}{2}-1} x_{N-1-n} \cos\left[\frac{[2(N-1-n)+1]\kappa\pi}{2(N/2)}\right] \right\}$$

$$= \sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} z_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + (-1)^k Z_k\right]$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + Z'_k\right] \qquad k = 0,1,\ldots,(N/2)-1.$$

and the odd coefficients $R_k = X_{2k+1}$ as

$$R_k = R_k^{'} - R_{k-1}$$

where

$$R_k^{'} = \sqrt{\frac{2}{N}}\left\{\sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k+1)\pi}{2N} + \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k-1)\pi}{2N}\right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}}\left\{\sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1}(y_n - z'_n)2\cos\frac{(2n+1)\pi}{2N}\cos\frac{(2n+1)k\pi}{2(N/2)}\right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}}\left\{\sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} r_n \cos\frac{(2n+1)k\pi}{2(N/2)}\right\}$$

or

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}}\{\text{ length-N/2 DCT-II of } r_n\}$$

where

$$r_n = (y_n - z'_n)2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Y_l \cos\frac{(2n+1)l\pi}{2(N/2)} - \sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Z'_l \cos\frac{(2n+1)l\pi}{2(N/2)}\right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l (Y_l - Z'_l)\cos\frac{(2n+1)l\pi}{2(N/2)} - \right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= g_n 2\cos\frac{(2n+1)\pi}{2N}$$

where

g_n is a length-N/2 IDCT of (Y_l - Z'_l), and where

$R'_k = X_{2k+1} + X_{2k-1}$.

or as

$$X_{2k+1} = \sqrt{\frac{2}{N}}\varepsilon_{2k+1}\sum_{i=0}^{N-1} x_i \cos\frac{(2i+1)(2\kappa+1)\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} x_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} x_{i+N/2} \cos\frac{(2i+N+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} z_i \cos\left[\frac{(2i+1)(2k+1)\pi}{2N} + (k\pi + \frac{\pi}{2})\right]\right\}.$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + (-1)^{k+1}\sum_{i=0}^{\frac{N}{2}-1} z_i \sin\frac{(2i+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}(X1_k - (-1)^k X2_k), \quad k = 0,1,\ldots,(N/2)-1.$$

18. The method of claim 15, N is equal to 2^m, m being a positive integer > 0.

19. A method of transcoding a digitalized image in the compressed discrete cosine transform (DCT) domain using DCTs of lengths N/2, comprising:

undersampling compressed frames by a certain factor in each dimension, and

calculating a DCT of length N x N directly from DCTs of length N/2 x N/2 for four adjacent blocks of size N/2 x N/2 of the digitalized image, N being a positive, even integer.

20. An encoder comprising:

- means for performing discrete cosine transform (DCT) transformation of a sequence of values of length N/2 to produce two sequences of coefficients of length N/2, N being a positive, even integer, and

- means for calculating the DCT of length N directly from the two sequences of coefficients of length N/2 without having to calculate a DCT of length N,

wherein the two sequences of coefficients represent the first half and second half, respectively, of an original sequence of values of length N.

21. A method of encoding a digitalized image represented as an original sequence of values of length N, N being a positive, even integer, wherein the DCT of length N is calculated directly from two sequences of coefficients obtained from DCTs of sequence of values of length N/2 without having to calculate a DCT of length N, the two sequences representing the first half and second half, respectively, of the original sequence of values of length N.

22. A method of transmitting a bit stream representing a digitalized image as a compressed video signal which includes coefficients obtained by calculating DCTs for blocks of size N/2 x N/2, the blocks being obtained by dividing the digitalized image, to a plurality of users, at least one of which requires a reduction of the bit stream or down-scaling of the corresponding compressed video signal, the method comprising:

receiving in a transcoder the bit stream of the compressed video signal;

extracting from the received bit stream the coefficients for the blocks of size N/2 x N/2;

collecting the extracted coefficients for four adjacent blocks of size N/2 x N/2, the groups of four adjacent blocks forming together non-overlapping blocks of size N x N in the digitalized image;

calculating, from the collected coefficients, coefficients of the DCTs for the blocks of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of the size N/2 x N/2 and without using DCTs or IDCTs of length N x N,

selecting, from the calculated coefficients, coefficients of the lowest frequencies; and

transmitting to the at least one user a bit stream including only the selected coefficients.

23. A method of transmitting a bit stream representing a digitalized image as a compressed video signal, which includes coefficients obtained by calculating DCTs for blocks of size N x N, the blocks being obtained by dividing the digitalized image, to a plurality of users, at least one of which requires a reduction of the bit stream or down-scaling of the corresponding compressed video signal, the method comprising:

receiving in a transcoder the bit stream of the compressed video signal;

extracting, from the received bit stream, the coefficients for the blocks of size N x N;

collecting the extracted coefficients for four adjacent blocks of size N x N, the groups of four adjacent blocks forming together non-overlapping blocks of size 2N x 2N in the digitalized image;

selecting, from the collected, extracted coefficients for each block of size N x N of each of the groups of four adjacent blocks of the size N x N, coefficients of N/2 x N/2 lowest frequencies;

calculating, from the selected coefficients for each of the groups, coefficients of the DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N, and

transmitting to the at least one user a bit stream including only the calculated coefficients.

24. The method of claim 23, wherein, in the step of calculating coefficients of DCTs for blocks of size N x N the even coefficients of a DCT of length N is calculated as:

$$X_{2k} = \sqrt{\frac{2}{N}}\varepsilon_{2k}\sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)2\kappa\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=N/2}^{N-1} x_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{2}{N}}\varepsilon_k \left\{ \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sum_{n=0}^{\frac{N}{2}-1} x_{N-1-n} \cos\left[\frac{[2(N-1-n)+1]\kappa\pi}{2(N/2)}\right] \right\}$$

$$= \sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} y_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} + \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} z_n \cos\frac{(2n+1)\kappa\pi}{2(N/2)} \right\}$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + (-1)^k Z_k\right]$$

$$= \sqrt{\frac{1}{2}}\left[Y_k + Z'_k\right] \qquad k = 0,1,\ldots,(N/2)-1.$$

and the odd coefficients $R_k = X_{2k+1}$ as

$$R_k = R'_k - R_{k-1}$$

where

$$R'_k = \sqrt{\frac{2}{N}} \left\{ \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k+1)\pi}{2N} + \sum_{n=0}^{N-1} x_n \cos\frac{(2n+1)(2k-1)\pi}{2N} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} (y_n - z'_n) 2\cos\frac{(2n+1)\pi}{2N} \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \left\{ \sqrt{\frac{2}{N/2}}\varepsilon_k \sum_{n=0}^{\frac{N}{2}-1} r_n \cos\frac{(2n+1)k\pi}{2(N/2)} \right\}$$

or

$$= \frac{1}{\varepsilon_k}\sqrt{\frac{1}{2}} \{ \text{ length-N/2 DCT-II of } r_n \}$$

where

$$r_n = (y_n - z'_n)2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Y_l \cos\frac{(2n+1)l\pi}{2(N/2)} - \sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l Z'_l \cos\frac{(2n+1)l\pi}{2(N/2)}\right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= \left\{\sqrt{\frac{2}{N/2}}\sum_{l=0}^{\frac{N}{2}-1}\varepsilon_l (Y_l - Z'_l)\cos\frac{(2n+1)l\pi}{2(N/2)} - \right\}2\cos\frac{(2n+1)\pi}{2N}$$

$$= g_n 2\cos\frac{(2n+1)\pi}{2N}$$

where

g_n is a length-N/2 IDCT of $(Y_l - Z'_l)$, and

$R'_k = X_{2k+1} + X_{2k-1}$,

or as

$$X_{2k+1} = \sqrt{\frac{2}{N}}\varepsilon_{2k+1}\sum_{i=0}^{N-1} x_i \cos\frac{(2i+1)(2\kappa+1)\pi}{2N}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} x_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} x_{i+N/2}\cos\frac{(2i+N+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + \sum_{i=0}^{\frac{N}{2}-1} z_i \cos\left[\frac{(2i+1)(2k+1)\pi}{2N} + (k\pi + \frac{\pi}{2})\right]\right\}.$$

$$= \sqrt{\frac{2}{N}}\left\{\sum_{i=0}^{\frac{N}{2}-1} y_i \cos\frac{(2i+1)(2k+1)\pi}{2N} + (-1)^{k+1}\sum_{i=0}^{\frac{N}{2}-1} z_i \sin\frac{(2i+1)(2k+1)\pi}{2N}\right\}$$

$$= \sqrt{\frac{2}{N}}(X1_k - (-1)^k X2_k), \quad k = 0,1,\ldots,(N/2)-1.$$

25. A transmission system for transmitting digitalized images where users are connected to each other through a multi-node control unit and bit streams of digitalized images corresponding to compressed video signals are transmitted between the users, the compressed video signal including coefficients obtained by calculating discrete cosine

transforms (DCTs) for blocks of size N/2 x N/2 obtained by dividing the digitalized image,

- a first one of the users, for receiving a bit stream transmitted from a second one of the users, requiring a reduction of the bit stream or down-scaling of the corresponding compressed video signal,

the multi-node control unit comprising:

- means for receiving said bit stream from the second one of the users and for extracting from the bit stream coefficients for blocks of size N/2 x N/2 in a corresponding digitalized image;

- means for collecting the extracted coefficients for four adjacent blocks of size N/2 x N/2;

- means for calculating from the collected coefficients coefficients for a DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N;

- means for selecting, from the calculated coefficients, coefficients for the lowest frequencies, and

- means for transmitting to the first one of the users a bit stream including only the selected coefficients.

26. A transmission system for transmitting digitalized images, the system including users connected to each other through a multi-node control unit,

- bit streams of digitalized images being compressed video signals being transmitted between the users, the compressed video signal for a digitalized image comprising coefficients obtained by calculating DCTs for blocks of size N x N obtained by dividing the digitalized image,

- a first one of the users, for receiving a bit stream transmitted from a second one of the users, requiring a reduction of the bit stream or down-scaling of the corresponding compressed video signal,

the multi-node control unit comprising:

- means for receiving said bit stream from the second one of the users and for extracting from the bit stream coefficients for blocks of size N x N in a corresponding digitalized image;

- means for collecting the extracted coefficients for four adjacent blocks of size N x N;

- means for selecting, from the extracted coefficients for each of the four adjacent blocks, coefficients for N/2 x N/2 lowest frequencies;

- means for calculating, from the selected coefficients, coefficients for a DCT for a block of size N x N using DCTs and IDCTs of length N/2 and without using DCTs or IDCTs of length N or using DCTs and IDCTs for blocks of size N/2 x N/2 and without using DCTs or IDCTs of length N x N; and

- means for transmitting to the first one of the users a bit stream including only the calculated coefficients.